Listening in the Ocean
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Listening in the Ocean provides a series of articles in the nascent field of marine acoustics dealing with the development of autonomous passive acoustic recorders and contains insights on the fascinating soundscape emerging before us in the oceans. Marine passive recorders originated from the need to detect nuclear detonations and evolved from the research on long term monitoring system of bottom mounted low-frequency seismic sensors. Since these sensors can detect underwater acoustic signals from the infrasonic to ultrasonic range, they have opened up a new vista of ocean filled with sounds from a wide array of biotic, abiotic and anthropogenic sources leading to the realization that sound is fundamental to many biological processes in the sea. However, the most intense activities have been directed to the effect of rapidly increasing levels of human generated noise in the ocean and its impact on communication, sensing, navigation and orientation of marine mammals. These articles mark the current state of research in developing new tools to record marine habitats throughout the world.

The first article (Chapter 1) introduces the history as well as the state of the art of the recording systems, both stationary and mounted on animals. The last article (Chapter 15) reviews the development of software needed to overcome the challenge of detecting and classifying sounds in presence of noise while managing very large datasets. In between there are thirteen articles focusing on the results of observations and identifying the roles and challenges of the distinctive signal analysis method or the recording system used.

Chapter 2 discusses the use of HARUphones (single hydrophone autonomous recording packages) on the pacific blue whales while Chapter 3 discusses the use of HARP (high-frequency acoustic recording packages) of baleen and beaked whales and high-frequency dolphins. These studies were pioneering ones establishing passive acoustic monitoring as a valuable tool for determining habitat ranges, species signal characterization, population density and abundance estimates etc. Chapter 4 analyses the soundscape in remote coral reef ecosystems from 2006 to 2009 at French Frigate Shoals in the Northwestern Hawaiian Islands using ecological acoustic recorders (EARs) establishing the use of passive acoustic monitoring (PAM) to study the behavior of fish habitats. Chapter 5 studies the use of EAR in observing foraging behavior of deep toothed whales at the western pacific including Hawaii focusing on echolocation of bisonar signals. Chapter 6 studies the employment of Environmental Acoustic Recording System (EARS) by the Littoral Acoustic Demonstration Center (LADC) in the Gulf of Mexico pioneering the use of buoys and focusing on click structure analysis for click-train demarcation and identification of individual whale species.

Chapter 7 then introduces the static acoustic monitors (SAM) — such as T-PODs, or their successor C-PODs (an omnidirectional hydrophone, a digital processor and timing system, battery pack and analysis software), that are designed to detect echolocation clicks with an adjustable band-passed frequency range and thus differ in the working principle from EARs used in Chapters 2 to 6. T-PODs, which require a priori knowledge of the click patterns used, were used to study Hector's Dolphin in New Zealand and river dolphins in the Amazon River, while the C-PODs, which overcomes the problem of having a priori knowledge, were used to report the results from Vaquita population in the Gulf of Mexico and Porpoises in the German Baltic. While these studies are the most important cited there are references to other studies in a variety of marine ecosystems.

The following Chapters 8 to 10 describe the establishment of cabled acoustic observatories open to analysis by civilian scientists. Chapter 8 describes the Perennial Acoustic Observatory in the Antarctic Ocean (PALAOA) developed to study the underwater behavior of cetaceans (whales, dolphins and porpoises) and pinnipeds (seals and sea lions). This is a cabled system with a radio link to a base station at which batches of data are transmitted to a home station in Germany via satellite link. Chapter 9 describes the ALOHA Cabled Observatory, an ocean-bottom observatory at Hawaii linked to the shore by a fiber optic cable primarily studying baleen whales. Chapter 10 discusses the results obtained from the instrumented ranges of the U.S. Navy using either single hydrophones or recording buoys.

Chapter 11 focuses on the pinniped sounds in the polar oceans, both Arctic and Antarctic, describing specific improvements necessary in the PAM systems for the polar environment. Chapter 12 covers the sounds produced by deep dwelling fishes followed by sounds recorded from benthic shrimps in Chapter 13. Chapter 14 then focuses on the information gathered by the use of acoustic tags — another class of acoustic recording devices that are small and light enough to attach to animals in the field using support structures that are connected to suction cups.

This book will prove very valuable to the beginning engineers, researchers and graduate students to survey the field of marine acoustics open to them and deciding on which fields to pursue. Each of the chapter includes a detailed list of reference that the investigator can use to gain detailed knowledge of either the results or the techniques used. The articles are succinct and comprehensible to persons having no detailed knowledge of the marine acoustics field. Taken together, the chapters convey both the challenges of the future research in the field and the knowledge of the marine soundscape of the world at this point of

time. The book also opens us up to the responsibility that we must ensure the continuance of marine life unhindered by sound generated by human activities and the respect due to the role of sound in the life of the marine animals.

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